WE CLAIM:

1. A process for depositing a highly uniform silicon-containing material on a surface, comprising:

providing a chamber having disposed therein a substrate, the substrate having a controlled temperature selected to establish substantially mass transport limited conditions for deposition using trisilane vapor;

introducing a gas including trisilane into the chamber at a flow selected for improving deposition uniformity relative to deposition using silane in place of trisilane; and

depositing a Si-containing film onto the substrate.

2. The process as claimed in Claim 1, wherein the Si-containing film is epitaxial.

3. The process as claimed in Claim 1, wherein the Si-containing film is polycrystalline.

4. The process as claimed in Claim 1, wherein the temperature is in the range of from about 450°C to about 750°C.

5. The process as claimed in Claim 4, wherein the temperature is in the range of from about 550°C to about 650°C.

6. The process as claimed in Claim 1, wherein the Si-containing film is deposited onto the substrate at a rate of about 50 Å per minute or higher.

7. The process as claimed in Claim 1, wherein the Si-containing film is deposited onto the substrate at a rate of about 100 Å per minute or higher.

8. The process as claimed in Claim 1, wherein the amorphous Si-containing film has a thickness non-uniformity across the substrate of about 5% or less.

9. The process as claimed in Claim 1, wherein the amorphous Si-containing film has a thickness non-uniformity across the substrate of about 1% or less.

10. The process as claimed in Claim 1, wherein the gas further comprises of one or more compounds selected from the group consisting of silane, germane, digermane, trigermane, NF_3, monosilylmethane, disilylmethane, trisilylmethane, tetrasilylmethane, and a dopant precursor.

11. The process as claimed in Claim 1, wherein the gas further comprises of digermane.

12. The process as claimed in Claim 1, wherein the chamber is a single-wafer, horizontal gas flow reactor.

13. The process as claimed in Claim 1, wherein the Si-containing film is selected from the group consisting of a microdot, a SiGe film, a SiGeC film, a SiN film, a silicon oxide film, a silicon oxynitride film, a boron-doped film, an arsenic-doped film, a phosphorous-doped film, an indium-doped film, an antimony-doped film, and a film having a dielectric constant of about 2.2 or lower.

14. The process as claimed in Claim 1, wherein the Si-containing film is silicon and the substrate is a material having a high dielectric constant.

15. The process as claimed in Claim 1, further comprising patterning the film to form a transistor gate electrode.

16. A process for depositing a Si-containing material on a surface, comprising:

providing a chemical vapor deposition chamber having disposed therein a substrate;

introducing a gas comprising trisilane to the chamber; and

depositing a Si-containing film onto the substrate at a temperature higher than 525°C, the film having a greater degree of uniformity at a substantially higher deposition rate than a comparable film made using silane in place of the trisilane.

17. The process as claimed in Claim 16, wherein the substrate is maintained at a temperature of about 550°C or higher.

18. The process as claimed in Claim 16, wherein the substrate is maintained at a temperature of about 620°C or higher.

19. The process as claimed in Claim 16, wherein the chamber is maintained at a total pressure between about 1 Torr and 60 Torr.

20. The process as claimed in Claim 16, wherein the substrate is maintained at a temperature in the range of 450°C to about 700°C.

21. The process as claimed in Claim 16, wherein the substrate is maintained at a temperature in the range of about 525°C to about 650°C.

22. The process as claimed in Claim 16, wherein the deposition is carried out at a rate of about 50 Å per minute or higher.

23. The process as claimed in Claim 16, wherein the deposition is carried out at a rate of about 100 Å per minute or higher.

24. The process as claimed in Claim 16, wherein the gas further comprises one or more compounds selected from the group consisting of germane, digermane, trigermane, NF_3, monosilylmethane, disilylmethane, trisilylmethane, tetrasilylmethane, and a dopant precursor.

25. The process as claimed in Claim 16, wherein the gas further comprises digermane.

26. The process as claimed in Claim 16, wherein the chemical vapor deposition chamber is a single-wafer, horizontal gas flow reactor.

27. The process as claimed in Claim 16, wherein the Si-containing film has a thickness non-uniformity of about 5% or less.

28. The process as claimed in Claim 16, wherein the Si-containing film has a thickness non-uniformity of about 1% or less.

29. The process as claimed in Claim 16, wherein the Si-containing film is selected from the group consisting of a microdot, a SiGe film, a SiGeC film, a SiN film, a silicon-oxygen film, a silicon-oxygen-nitrogen film, a boron-doped film, an arsenic-doped film, an indium-doped film, an antimony-doped film, a phosphorous-doped film, and a film having a dielectric constant of about 2.2 or lower.

30. The process as claimed in Claim 16, wherein the Si-containing film is silicon and the substrate is a material having a high dielectric constant.

31. The process as claimed in Claim 16, wherein the Si-containing film is epitaxial.

32. The process as claimed in Claim 16, wherein the Si-containing film is polycrystalline.

33. The process as claimed in Claim 16, wherein the Si-containing film is amorphous.

34. The process as claimed in Claim 16, further comprising patterning to form a transistor gate electrode.

35. A compound Si-containing film in an integrated circuit, the compound Si-containing film having a thickness non-uniformity of about 5% or less and a compositional non-uniformity across the film of about

20% or less for elements representing 1 atomic % or greater of the film; and

75% or less for elements representing 0.001 atomic % to 1 atomic % of the film.

36. The Si-containing film as claimed in Claim 35, contained in a transistor gate electrode.

37. The Si-containing film as claimed in Claim 35, having a thickness non-uniformity of about 1% or less.

38. The Si-containing film as claimed in Claim 35, comprising SiGe.

39. The Si-containing film as claimed in Claim 35, comprising polycrystalline material.

40. The Si-containing film as claimed in Claim 35, comprising amorphous material.

41. A process for depositing a SiGe material on a surface, comprising

providing a chemical vapor deposition chamber having disposed therein a substrate,

introducing a gas comprised of a higher-order silane and a higher-order germane to the chamber; and

depositing a SiGe film onto the substrate.

42. The process as claimed in Claim 41, wherein the higher-order silane is selected from the group consisting of disilane, trisilane, and tetrasilane.

43. The process as claimed in Claim 41, wherein the higher-order germane is selected from the group consisting of digermane, trigermane and tetragermane.

44. The process as claimed in Claim 41, wherein the higher-order silane is trisilane and the higher-order germane is digermane.

45. The process as claimed in Claim 41, wherein the depositing is carried out at a temperature in the range of 475°C to about 700°C.

46. The process as claimed in Claim 41, wherein the depositing is carried out at a rate of about 50 Å per minute or higher.

47. The process as claimed in Claim 41, wherein the depositing is carried out at a rate of about 100 Å per minute or higher.

48. The process as claimed in Claim 41, wherein the gas further comprises one or more compounds selected from the group consisting of monosilylmethane, disilylmethane, trisilylmethane, tetrasilylmethane, and a dopant precursor.

49. The process as claimed in Claim 41, wherein the chemical vapor deposition chamber is a single-wafer, horizontal gas flow reactor.

50. The process as claimed in Claim 41, wherein the SiGe film has a thickness non-uniformity of 5% or less.

51. The process as claimed in Claim 41, wherein the SiGe film has greater uniformity than a comparable film made using silane in place of the higher-order silane.

52. The process as claimed in Claim 41, wherein the SiGe film has greater uniformity than a comparable film made using germane in place of the higher-order germane.

53. The process as claimed in Claim 41, further comprising patterning to form a transistor gate electrode.

54. A SiGe film in an integrated circuit, the SiGe film having a thickness non-uniformity of about 5% or less and a compositional non-uniformity of about 15 % or less.

55. The SiGe film as claimed in Claim 54, wherein the SiGe film is contained in a transistor gate electrode.

56. The SiGe film as claimed in Claim 54, the SiGe film having a thickness non-uniformity of about 1% or less and a compositional non-uniformity of about 10 % or less.

57. A process for depositing a Si-containing material on a surface, comprising

providing a chemical vapor deposition chamber having disposed therein a substrate, the chemical vapor deposition chamber being equipped with a temperature controller configured to allow programming with multiple temperature control variables for a single recipe;

entering a temperature control variable T_1 into the temperature controller;

introducing a first gas comprised of X_1% of a first Si-containing chemical precursor to the chamber; wherein the X_1 is in the range of about 1×10^{-4} to about 100;

depositing a first Si-containing layer onto the substrate;

entering a temperature control variable T_2 into the temperature controller,

introducing a second gas comprised of X_2% of a second Si-containing chemical precursor to the chamber, wherein the X_2 is in the range of about 1×10^{-4} to about 100 and wherein the second silicon source is the same as, or different from, the first silicon source;

depositing a second Si-containing layer onto the first Si-containing layer, thereby forming a multi-layer Si-containing film having a thickness non-uniformity of about 5% or less and a compositional non-uniformity of about

20% or less for elements representing 1 atomic % or greater of the film; and

75% or less for elements representing 0.001 atomic % to 1 atomic % of the film.

58. The process as claimed in Claim 57, wherein the temperature control variables T_1 and T_2 are temperature control set points.

59. The process as claimed in Claim 57, which further comprises

entering a temperature control variable T_3 into the temperature controller,

introducing a third gas comprised of X_3% of a third Si-containing chemical precursor to the chamber,

depositing a third Si-containing layer onto the second Si-containing layer.

60. The process as claimed in Claim 57, wherein at least one of the first Si-containing chemical precursor and the second Si-containing chemical precursor is selected from the group consisting of silane, disilane and trisilane.

61. The process as claimed in Claim 57, wherein at least one of the first gas and the second gas comprises a compound selected from the group consisting of germane, digermane, trigermane, NF_3, monosilylmethane, disilylmethane, trisilylmethane, tetrasilylmethane, and a dopant precursor including silylphosphines and silylarsines.

62. The process as claimed in Claim 57, wherein the substrate has a temperature of about 350°C or higher.

63. The process as claimed in Claim 57, wherein the substrate has a temperature in the range of 475°C to about 700°C.

64. The process as claimed in Claim 57, wherein the chemical vapor deposition chamber is a single-wafer, horizontal gas flow reactor.

65. The process as claimed in Claim 57, wherein the multiple layer Si-containing film is selected from the group consisting of a microdot, a SiGe film, a SiGeC film, a SiN film, a silicon-oxygen film, a silicon-oxygen-nitrogen film, a boron-doped film, an arsenic-doped film, an indium-doped film, an antimony-doped film, a phosphorous-doped film, an amorphous film, a polycrystalline film, an epitaxial film, and a film having a dielectric constant of about 2.2 or lower.

66. An apparatus for depositing a Si-containing material on a surface, comprising

a chemical vapor deposition chamber,

a vessel containing trisilane,

a feed line operatively connecting the vessel to the chemical vapor deposition chamber to allow passage of the trisilane from the vessel to the chemical vapor deposition chamber, and

a temperature controller operatively disposed about the vessel and maintained at a temperature between about 10°C and 70°C, to thereby control the vaporization rate of the trisilane.

67. The apparatus as claimed in Claim 66, further comprising a manifold operatively connected to the feed line to control the passage of the trisilane from the vessel to the chemical vapor deposition chamber.

68. The apparatus as claimed in Claim 66, wherein the temperature controller is a heating blanket, heating bath or heating lamp.

69. The apparatus as claimed in Claim 66, wherein the chemical vapor deposition chamber is a single-wafer, horizontal gas flow reactor.

70. The apparatus as claimed in Claim 66, wherein the vessel is a bubbler equipped with a carrier gas source, wherein the carrier gas is selected from the group consisting of hydrogen, helium, neon, argon, krypton and nitrogen.

71. The apparatus as claimed in Claim 70, wherein the carrier gas is hydrogen.

72. The apparatus as claimed in Claim 70, which further comprises a heat source operatively disposed about the feed line and maintained at a temperature between about 35°C and 70°C to thereby reduce condensation of trisilane within the feed line.

73. The apparatus as claimed in Claim 66, wherein the temperature controller is maintained at a temperature between about 15°C and 52°C.

10 ~~74~~. The process as claimed in Claim ~~13~~ 15, wherein the film is deposited over a gate dielectric material having a dielectric constant greater than about 5.

17 ~~75~~. The process as claimed in Claim ~~74~~ 16, wherein the gate dielectric comprises aluminum oxide, zirconium oxide or hafnium oxide.

18 ~~76~~. The process as claimed in Claim 1, wherein the Si-containing film comprises a silicon oxide.

19 ~~77~~. The process as claimed in Claim 1, wherein the Si-containing film comprises a silicon oxynitride.

20 ~~78~~. The process as claimed in Claim 1, wherein the Si-containing film comprises a silicon nitride.

21 ~~79~~. The process as claimed in Claim 1, wherein the gas further comprises a nitrogen source.

22 ~~80~~. The process as claimed in Claim ~~79~~ 21, wherein the nitrogen source is selected from the group consisting of NF_3, trisilylamine, atomic nitrogen, and ammonia.

23 ~~81~~. The process as claimed in Claim ~~80~~ 22, wherein the nitrogen source is atomic nitrogen.

24 ~~82~~. The process as claimed in Claim ~~80~~ 22, wherein the trisilane is introduced in pulses.

25 ~~83~~. The process as claimed in Claim ~~80~~ 22, wherein the Si-containing film is a SiN film having a thickness in the range of about 10 Å to about 300 Å.